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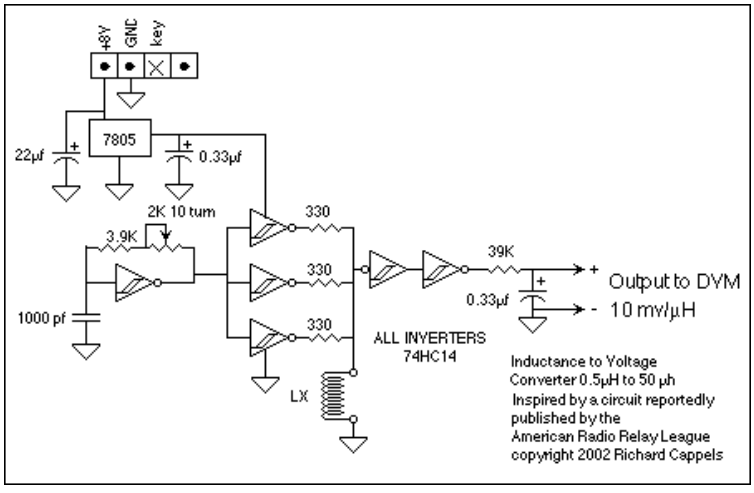
RF Inductance Meter

To measure RF chokes in the 500 nH to 50 uH range.

L meter measuring 900 nH inductor

Check the HOME page for other projects including other inductance and LC meters.

I needed a way to measure hand-wound RF inductors in my second lab, and since I would only be doing this occasionally, I didn't need anything fancy, and since once a friend finishes his AT90S1200-based design, I plan to make one myself, I figured I'd use this for less than a year, so I didn't want to invest a lot of time in making it . I had run across the forerunner of this circuit, one that is more sophisticated in that it has a zero adjustment and range switch, but it was limited to higher inductances. I adapted it to the components I had on hand and changed it so that it would work in the 500 nanohenry to 50 microhenry range.The original circuit was reportedly published a few years ago by the Amrican Radio Relay League, so it is with appreciation of the ARRL that I make this circuit available (Wouff Hong members: dit dit dit dit....dit dit).



The Circuit

The circuit's operating principle is that if you make a pulse width proportioal to inductance, and keep the pulse frequency and amplitude constant, and then pass the pulse through a low pass filter so that only the average voltage comes out, the resulting DC voltage is proportional to the inductance.

Stated another way:
Pulse width = Inductance X some constant
DC out = Pulse width X Pulse Ampltude X Freqency
Where DC out and Pulse Amplitude is in volts, and Pulse width is in seconds and pulse frequency is in Hz (1/seconds).

The pulse frequency is set by a schmitt trigger oscillator composed of a feedback resistance (2k pot and 3.9k fixed resistor). a 1000 pf capacitor to ground, and a schmitt trigger. The hysteresis in the schmitt trigger allows it to oscillate with the simple feedback circuit. The pulse width that is proportional to the inductance is made by drving the unknown inductance through a resistor and connecting the resultant sawtooth waveform to the input of another schmitt trigger which, because of the sharp switching action on its output that results from its hysteresis, provides a nice rectangualr pulse. The pulse width is proportional to the inductance and inversely proportional to the resistance. In order to get a pulse with a width that is substantiall longer than the rise and fall time of the schmitt trigger, whcih is a requiremnt for good linearity, while the inductance was in the 500 nH range, I had to use a very low resistance, hence the three 330 ohm resistors and their drivers in parallel. The last inverter in merely to make the pulse positive in polarity so that the voltage increases as the inductance increases.

This circuit is only accurate for broadband inductors. Inductors with iron cores, high permeability ferrites, or with large amonts of shunt capacitance cannot be measured accurately.

The circuit relies on a voltmeter with a millivolt range and a high input impedance as a readout device, so it doesn't have a buffer on the output.

I happned to have the 74HC14 in an SO package so I soldered it onto the metalized side of a prototyping board. If you use a DIP, your life will be much easier. When you built this, keep the connections, including gorund connections, short because tens of nanoseconds count. Pay particular attention to the leads and contacts for LX. Any inductance in that path will add to the measured inductance, so keep it short and small. In the one I built I used a pair of alligator clips soldered to stout wires a couple of cm long.

Calibration:

The procedure is straightforward: Connect a battery and a DVM (digital volt meter), put a known inductor in the LX position then adjust the potentiometer until you get the anticipated reading on the DVM. For example, use a 1 microhenry inductor and adjust the potentiometer to get 100 mv on the DVM.

You might have some trouble getting the thing to calibrate if the switching thresholds on your 74HC14 are very different from the one I used, so you might have to change the resistance in the osicllator or the capacitor in order to claibrate the circuit.

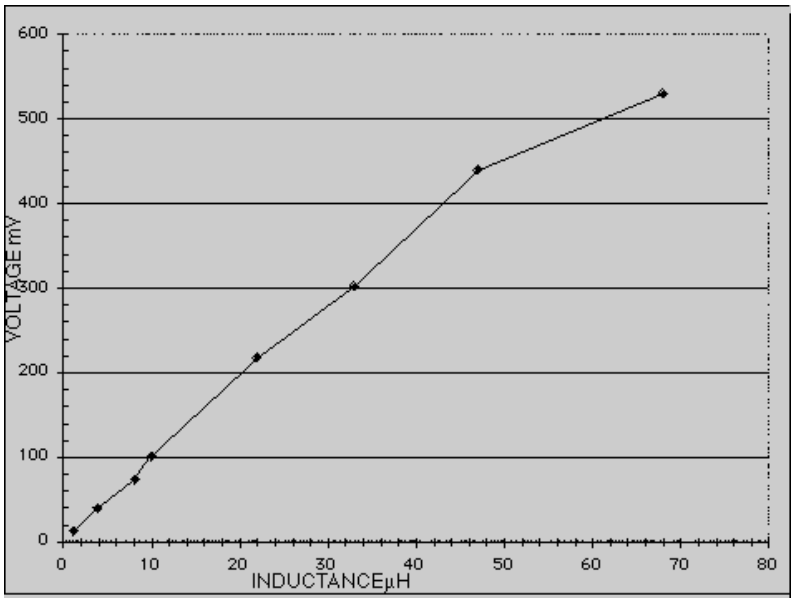
Here are some things to check when calibrating:

-When LX is shorted, the output should be very close to zero volts. If not, you may have too much inductance in the leads to LX or have connected LX to a noisey ground point. There is a remote possibility that you are using a damaged 74HC14, but check this last since it isn't very likely.

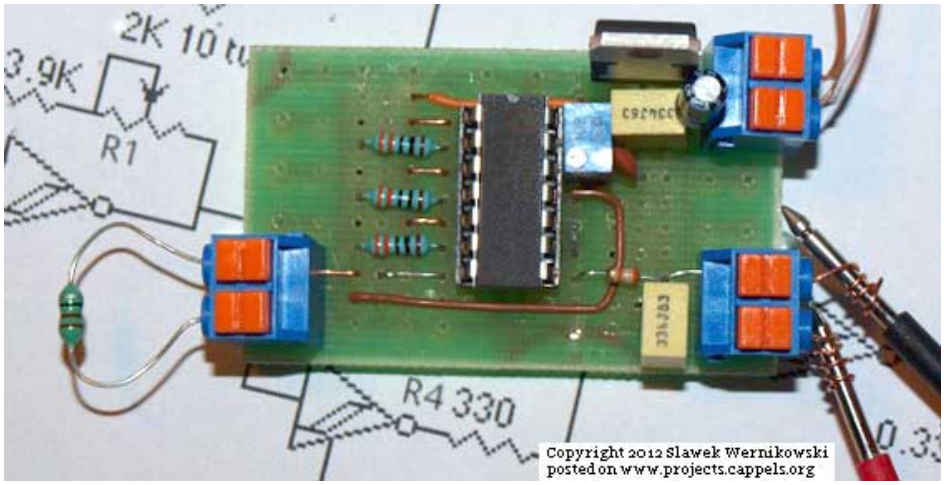
-When LX is open, the ouput should be around 2.5 volts (50% of the power supply). If it isn't, its probably because the thresholds on the 74HC14 are not symmetrically positioned

around 2.5 volts. Never mind, just adjust the oscillator frequency until you get it to calibrate. If you find the voltage to be very low, say under a volt, then this points to a wriing error, a problem with the 5V regulator or the battery, a damaged 74HC14, or you are using a very low resistance voltmeter. DVMs tend to be 10 Meg Ohms but VOMs (Volt-Ohm-Meters) can be down in the 10K to 20K range and are not suitable for this use.

-The oscillator in the one I made runs at 173 KHz. If yours runs at a greatly different frequency, try changing the oscillator components or try using a 74HC14 made by a different manufacturer.



The circuit gives a pretty constant 10mv/uH through 50 uH.



Take a look at this great looking printed circuit
ersion made by Slawek Wernikowski of Poland.

Read about when Alan Yates, VK2ZAT built this circuit. http://www.vk2zay.net/article/92

Check the HOME page for other projects including other inductance and LC meters.

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